EMC Technologies (NZ) Ltd

Test Report No **70418.1**
Report date: 08 May 2007

TEST REPORT

SIMOCO SRM9000 AC / MACOM M3300
VHF Mobile Transceiver

tested to the

Code of Federal Regulations (CFR) 47

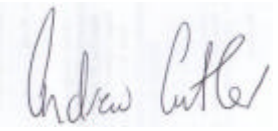
Part 90 –Private Land Mobile Services

Part 22 – Public Mobile Services

Part 15 – Radio Frequency Device

for

TMC Radio Pty Ltd



This Test Report is issued with the authority of:

_____
Andrew Cutler - General Manager

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

EMC Technologies (NZ) Ltd

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1. CLIENT INFORMATION

Company Name	TMC Radio Pty Ltd
Address	1270 Ferntree Gully Road Scoresby
City	Victoria, 3179
Country	Australia
Contact	Mr Robert Stowell

2. DESCRIPTION OF TEST SAMPLE

Brand Name	SIMOCO / MACOM
Model Number	SRM9000 AC / M3300
Product	VHF Mobile Transceiver
Manufacturer	TMC Radio Pty Ltd
Designed in	Australia
Manufactured in	Taiwan
Serial Number	ARACX0710212W
FCC ID	STZSRM9000AC

Since this radio was originally FCC certified a number of changes have been made.

Testing has been carried out to determine the level of permissive change.

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The following changes have been made:

1. The Radio is now also branded under the MACOM brand name with a model number of M3300.

For the SIMOCO brand the appearance of the radio in unchanged however under the MACOM brand the case is now black.

2. Provision has now been made for an add on option board containing a co-processor and additional memory

3. Component sizes have been changed from 0603 to 0402.

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3. COMPLIANCE STATEMENT AND RESULT SUMMARY

The **SIMOCO SRM9000 AC/ MACOM M3300 VHF Mobile Transceiver** complies with the limits defined in 47CFR 15, 47CFR22, 47 CFR Part 90 and 47 CFR Part 2 when tested in-accordance with the test methods described in 47 CFR Part 2.

CLAUSE	TEST PERFORMED	RESULT
90.203	Certification required	Complies
2.1046	RF power output	Noted
90.205	Power and antenna height limits	Complies
2.1047	Modulation Characteristics	
2.1047(a)	Low pass filter response	Complies
2.1047(b)	Modulation limiting characteristics	Complies
90.211(a)	Modulation characteristics	Complies
2.1049	Occupied bandwidth	Noted
2.202	Bandwidths	Noted
22.357	Emission types	Complies
22.359(a)	Emission masks	Complies
90.207	Types of emissions	Complies
90.209	Bandwidth limitations	Complies
90.210	Emission masks	Complies
2.1051	Spurious emissions at antenna terminals	Complies
2.1053	Field strength of spurious radiation	Complies
2.1055	Frequency stability	Noted
22.355	Frequency tolerance	Complies
90.213	Frequency stability	Complies
90.214	Transient frequency behaviour	Complies
15.109	Radiated emission limits	Complies
15.111	Antenna conducted power measurement	Complies
1.1310	Radio frequency radiation exposure limits	Complies

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4. TEST SAMPLE DESCRIPTION

The sample tested has the following specifications:

Rated Transmitter Output Power

25.0 Watts (44.0 dBm)

Transmitter frequency range

150 – 174 MHZ

Test frequencies

Chl	Frequency MHz	Power Watts	Spacing kHz
1	150.075	25.0	12.5
2	162.075	25.0	12.5
3	173.975	25.0	12.5
4	150.075	25.0	25.0
5	162.075	25.0	25.0
6	173.975	25.0	25.0

FCC Bands

Part 90: 150-174 MHz
Part 22: 150-174 MHz

Emission Designators / Modes of operation

11k2F3E – Analogue speech
11k2F1D – 1200 baud FFSK
8k10F1E – C4FM digital speech

16k0F3E – Analogue speech
16k0F1D – 1200 baud FFSK

Power Supply

External DC voltage supply. Typically 13.8 Vdc

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5. TEST CONDITIONS

Standard Temperature and Humidity

Temperature: +25°C ± 4° maintained.
Relative Humidity: 60% ± 10% observed.

Standard Test Power Source

Standard Test Voltage: 13.8 Vdc.

Extreme Temperature

High Temperature: + 50°C maintained.
Low Temperature: - 30 °C maintained.

Extreme Test Voltages

High Voltage: 15.9 Vdc
Low Voltage: 11.7 Vdc

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6. ATTESTATION

The **SIMOCO SRM9000 AC/ MACOM M3300 VHF Mobile Transceiver** complies with the Code of Federal Regulations (CFR) 47 Part 90 –Private Land Mobile Services , Part 22 – Public Land Mobile Services and 47 Part 15 – Radio Frequency Devices.

This report describes the tests and measurements performed for the purpose of determining compliance with the specification with the following conditions:

The client selected the test sample.

The report relates only to the sample tested.

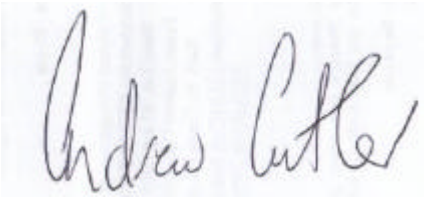
This report does not contain corrections or erasures.

Measurement uncertainties with statistical confidence intervals of 95% are shown below test results. Both Class A and Class B uncertainties have been accounted for, as well as influence uncertainties where appropriate.

In addition this equipment has been tested in accordance with the requirements contained in the appropriate Commission regulations.

To the best of my knowledge, these tests were performed using measurement procedures that are consistent with industry or Commission standards and demonstrate that the equipment complies with the appropriate standards.

I further certify that the necessary measurements were made by EMC Technologies NZ Ltd, 47 MacKelvie Street, Grey Lynn, Auckland, New Zealand.



Andrew Cutler
General Manager
EMC Technologies NZ Ltd

7. TEST RESULTS

Certification required

Certification was granted to this transceiver before January 1st, 2005 under section 90.203(j)(2)(ii).

A new certification will not be required as when the equipment was originally certified it was certified with both wide and narrow band capabilities and the testing carried out is only intended to demonstrate continued compliance due to changes made to the radio.

Result: Complies.

RF power output

Measurements were carried out at the RF output terminals of the transmitter using a 30 dB power attenuator and a 50 O dummy load. Measurements were carried out when the transmitter was not being modulated. Measurements were made with the input voltage set to 13.8 Vdc and when varied +/- 15%. Testing was carried out at maximum power output.

Frequency	Voltage (Vdc)	Rated (dBm)	Measured (dBm)
150.075	13.8	44.0	43.8
162.075	13.8	44.0	43.7
173.975	13.8	44.0	43.7

Frequency	Voltage (Vdc)	Rated (dBm)	Measured (dBm)
162.075	11.7	44.0	43.6
162.075	13.8	44.0	43.7
162.075	15.9	44.0	43.7

Limits:
Clause 90.205(d) of Part 90 specifies that in the band 150 – 174 MHz the maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and the required service area.
Part 22 does not specify the transmitter output power.

Result: Complies
Measurement Uncertainty: *±0.5 dB*

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Modulation Characteristics

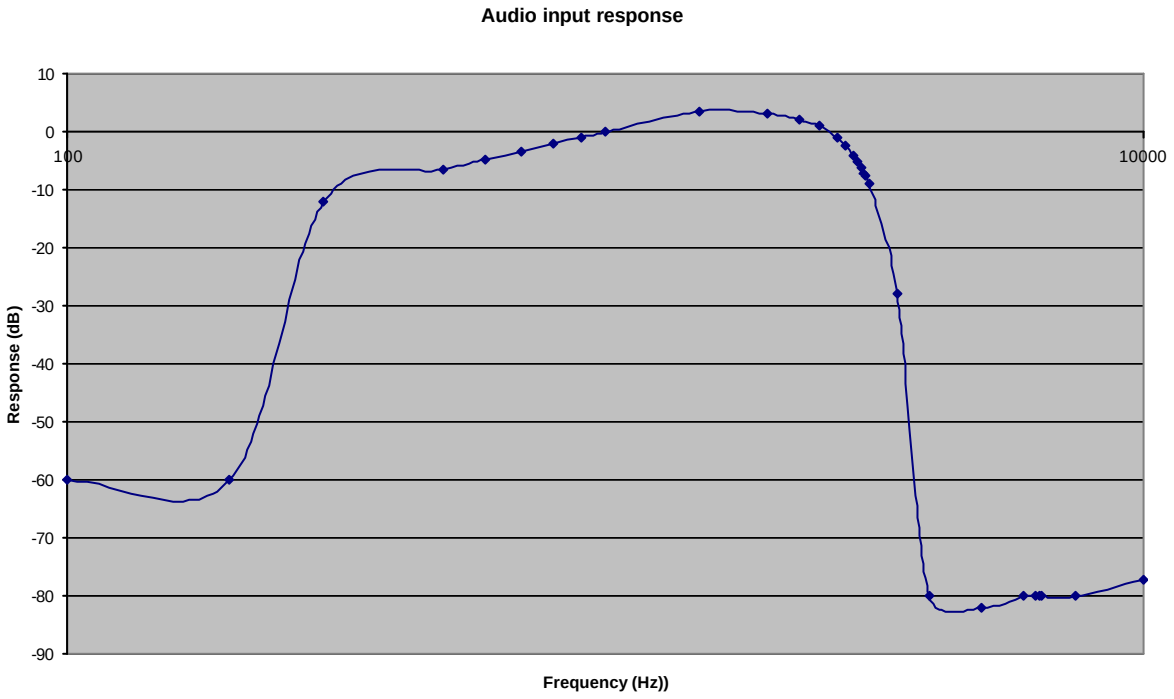
This transmitter is capable of producing analogue speech and digital speech modulations.

(a) Frequency response of the audio frequency low pass filter between 100 Hz and 15 kHz.

This measurement was carried out using an audio signal generator and an audio modulation analyser.

At 1 kHz an audio signal was applied which was used as a 0 dB response reference.

The frequency of the input signal was then varied and the output response noted. This measurement was carried out from 100 Hz to 5000 Hz as required by Part 2 with further measurements carried out in order to show the full range of this filter.



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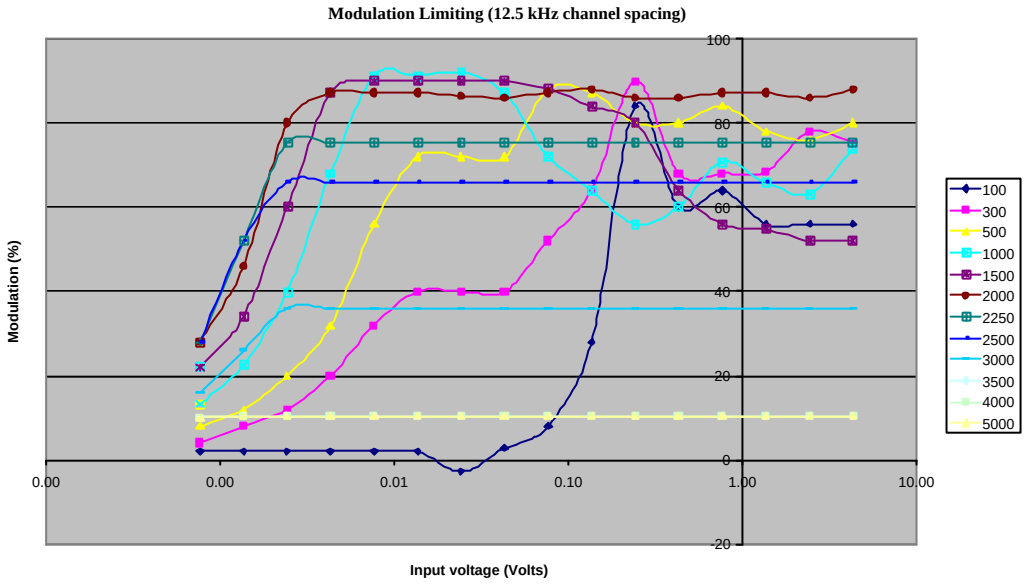
(b) A family of curves showing the percentage of modulation versus the modulation input voltage.

Measurements were made between 100 Hz to 4 kHz.

At each frequency the input voltage was slowly increased with the resulting frequency deviation of the transmitter being recorded.

This deviation was then converted to a modulation percentage where 5 kHz deviation is 100% for 25 kHz channels and 2.5 kHz deviation is 100% for 12.5 kHz channels.



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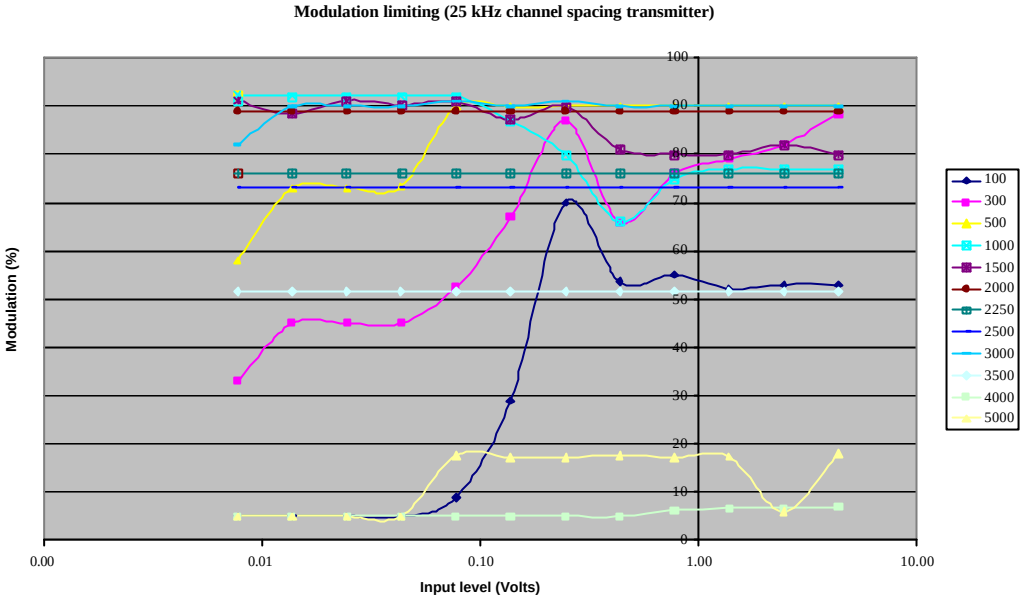

(d) A curve or equivalent data that shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Digital modulation as detailed below is also used with this transmitter.

The types of modulation used are:

C4FM digital modulation is used for digital telephony (F1E).

1200 baud FFSK data is used for data transmissions (F1D).

Limit:
Part 90.211 – Modulation requirements states the transmitter must meet the emission requirements of 90.210. Refer to the Occupied Bandwidth measurements in this report.

Result: Complies

Measurement Uncertainty: ±1%.

Part 90.207 – Emission types:

The following emission types are used:

- F3E: Frequency modulation with analogue speech.

- F1E: Digital telephony using C4FM.

- F1D: Data transmission using 1200 baud FFSK data.

Part 90.209 – Bandwidth limitations:

The authorised bandwidth is taken to be the necessary bandwidth.

Using the formulas contained in Part 2.202 the necessary bandwidth calculation for the 25 kHz channel step emission is:

$B_n = 2 \times D + 2 \times M$
Where D = maximum deviation: 5.0 kHz
Where M = maximum modulation frequency: 3 kHz
$B_n \leq$ 16 kHz

This is confirmed in the emission designation, 16k0F3E, declared by the client.

Using the formulas contained in Part 2.202 the necessary bandwidth calculation for the 12.5 kHz channel step emission is:

$B_n = 2 \times D + 2 \times M$
Where D = maximum deviation: 2.5 kHz
Where M = maximum modulation frequency: 3 kHz
$B_n \leq$ 11 kHz

This is confirmed in the emission designation, 11k0F3E, declared by the client.

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Part 22.359– Bandwidth limitations:

Part 22.359(a) – Analog modulation. No authorised bandwidth is defined.

The necessary bandwidth is taken to be the authorised bandwidth.

Using the formulas contained in Part 2.202:
$B_n = 2 \times D + 2 \times M$
Where D = maximum deviation: 2.5 kHz or 5.0 kHz
Where M = maximum modulation frequency: 3 kHz
$B_n =$ 11.0 kHz or 16 kHz

This is confirmed in the emission designations, 11k0F3E and 16k0F3E as declared by the client.

This transmitter can also transmit digital telephony and data using F1E and F1D.

Using the tables in Part 2.202 – Bandwidth, bandwidths for the F1D and F1E emissions could not be determined easily.

Therefore the occupied bandwidth has been measured and compared against the occupied bandwidth declared by the client.

Measurements have been made of each modulation type using a spectrum analyser operating in peak hold mode and a 30 dB attenuator.

Initially power measurements are made using a resolution bandwidth of 120 kHz.

This level is used as a reference level on the spectrum analyser.

The resolution bandwidth is then changed to 100 Hz and the reference level minus 23 dB (99%) absolute bandwidth points determined

However in keeping with the method used previously the F1D bandwidths have been measured relative to the 100 Hz bandwidth maximum.

The F1E bandwidth has been measured using the above described method.

Emission	Channel	Measured	Designation
F1D	12.5 kHz	7.200 kHz	11k0FID
F1E	12.5 kHz	7.800 kHz	8k10F1E
F1D	25.0 kHz	11.150 kHz	16k0F1D

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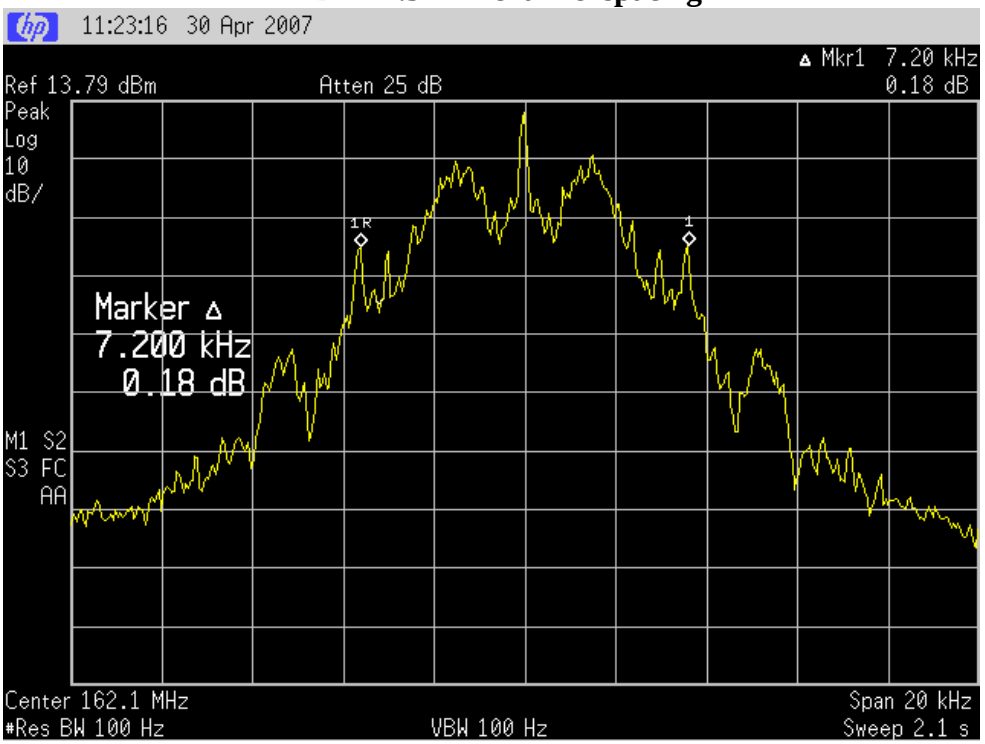
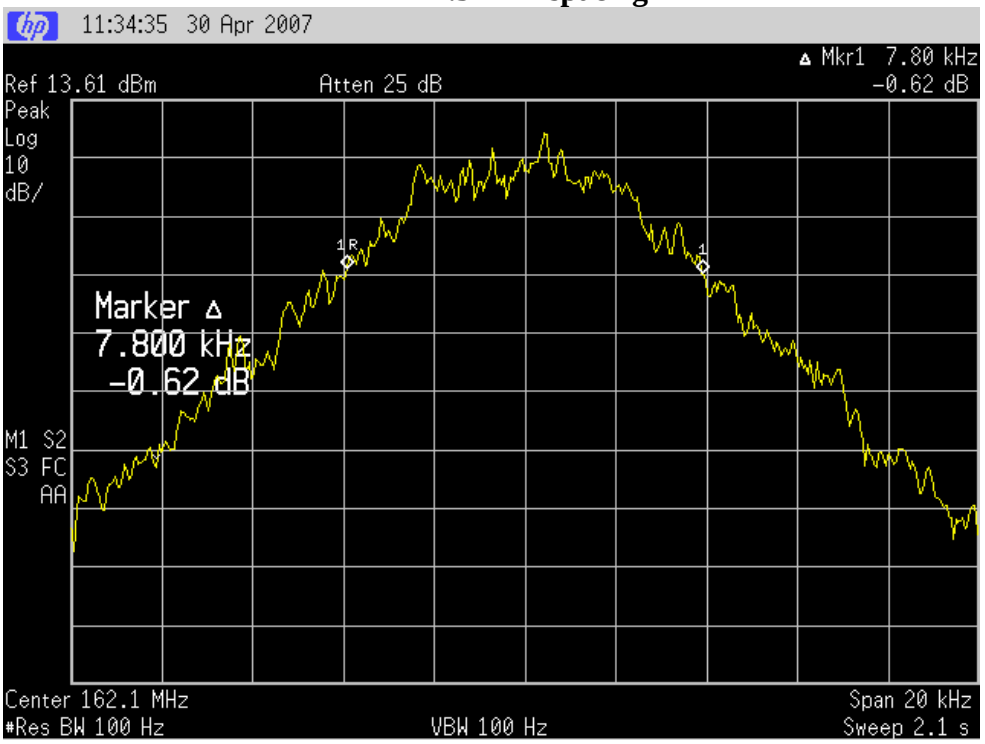
F1D – 12.5 kHz channel spacing



F1E – 12.5 KHz spacing



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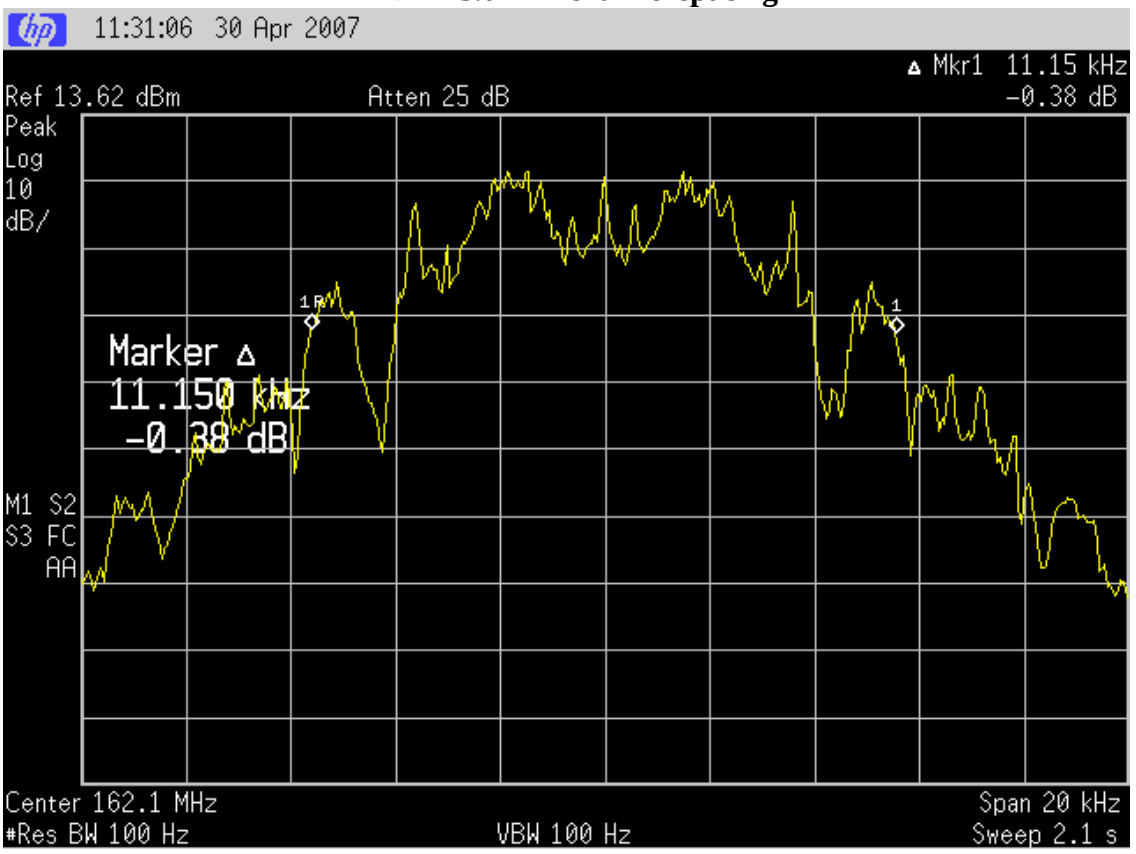
F1D – 25.0 kHz channel spacing



Result: Complies

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Occupied Bandwidth

The spectrum masks are defined in:

Section 90.210(d) – Masks B and D have been applied as the transmitter can operate in the band 150 – 174 MHz using an authorised bandwidth of 20.0 kHz and 11.25 kHz as per Section 90.209(b)(5).

The reference level for the following emission mask measurements has been determined using a resolution bandwidth of 30 kHz with the transmitter not being modulated.

All measurements have been made with a 30 dB attenuator being placed between the transmitter and the spectrum analyser.

Measurements were made in peak hold with the transmitter operating on 162.075 MHz.

When operating in F3E mode a 2500 Hz tone, which was found to be the frequency of maximum response, that was applied at a level 16 dB higher than that required to achieve 50% modulation.

For the F1E and F1D modes the transmitter was modulated uses modulation sources internal to the transmitter as supplied by the client.

Section 22.359(a) has been applied when analogue speech is utilised. The authorised bandwidth is taken as the necessary bandwidth which has been determined by calculation.

The 12.5 kHz transmitter has an authorised bandwidth (necessary bandwidth calculated) of 11 kHz applied and the 25 kHz transmitter has an authorised bandwidth of 16 kHz applied

Section 22.359(b) (1) has been applied when F1D and F1E are utilised. Authorised bandwidths of 7.2, 7.8 and 11.15 kHz (based upon the measured occupied bandwidths) have been applied.

Result: Complies

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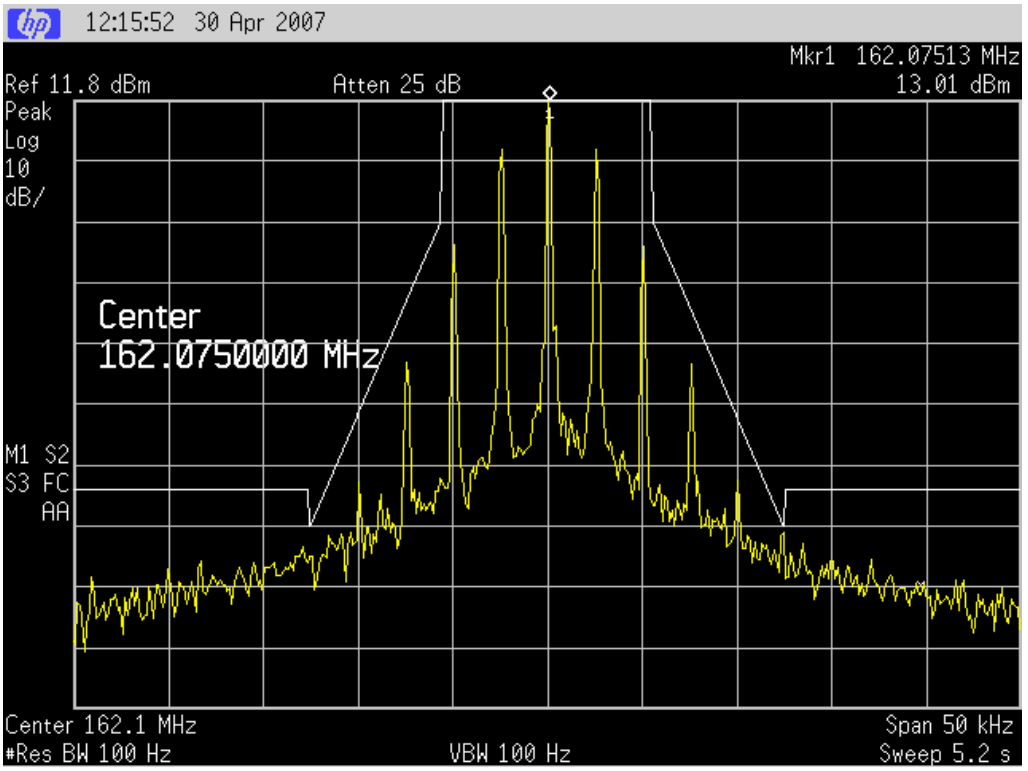
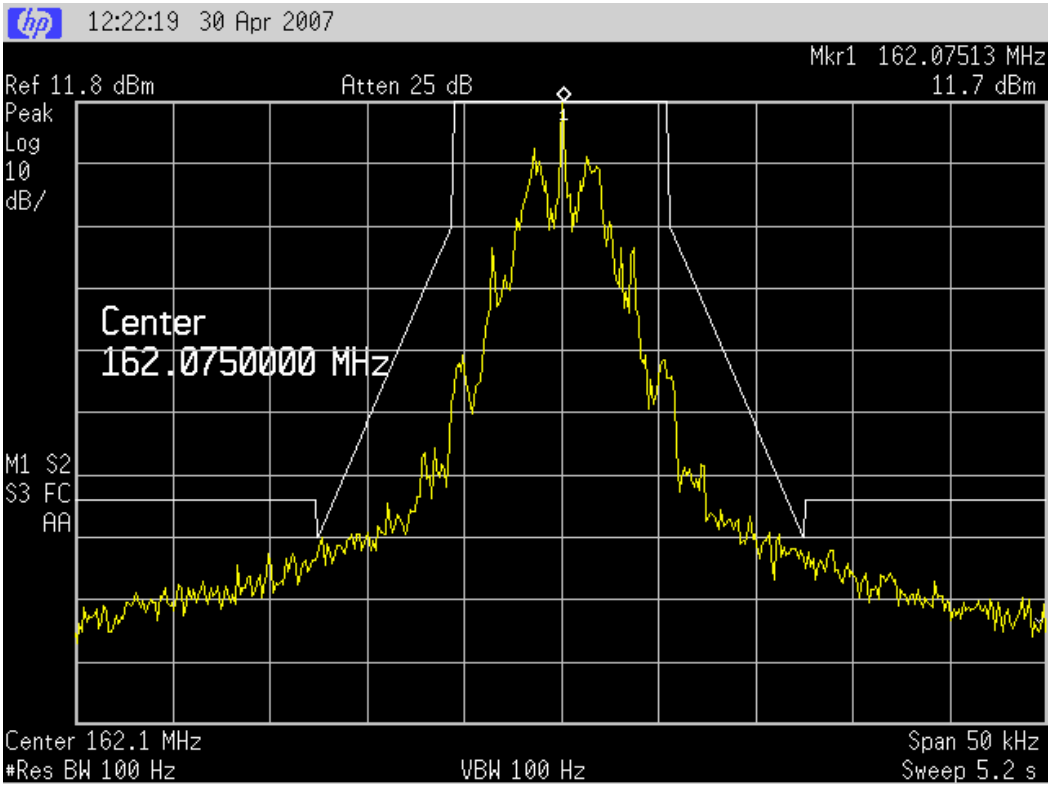
Part 90: F3E 12.5 kHz



Part 90: F1D 12.5 kHz



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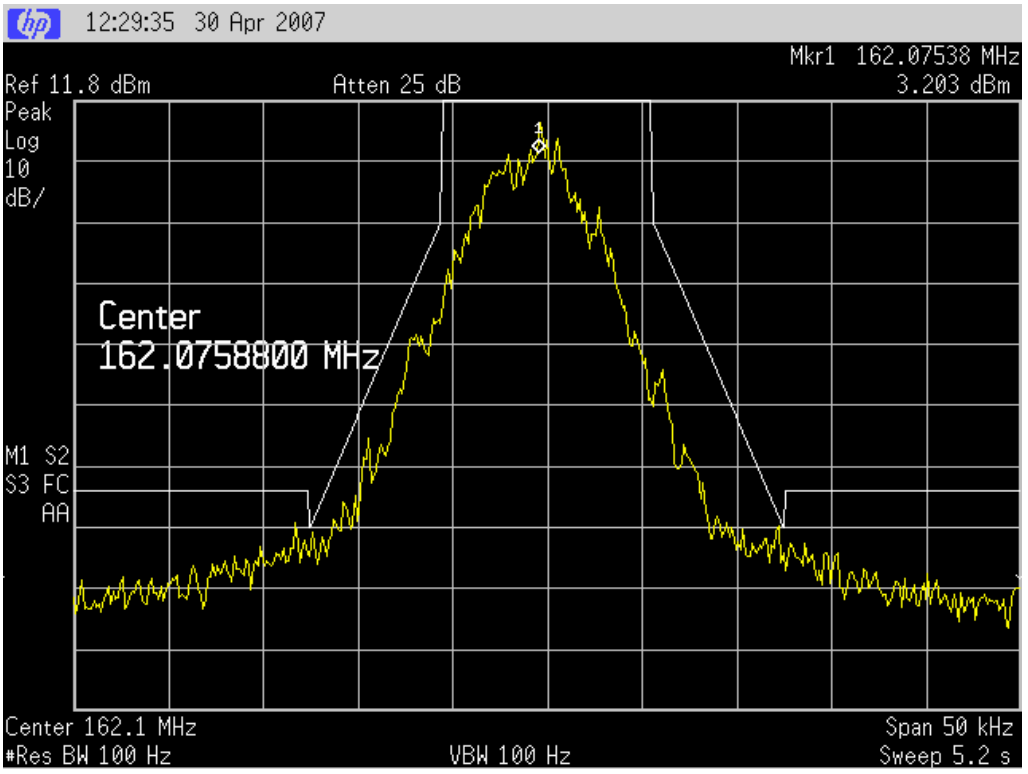
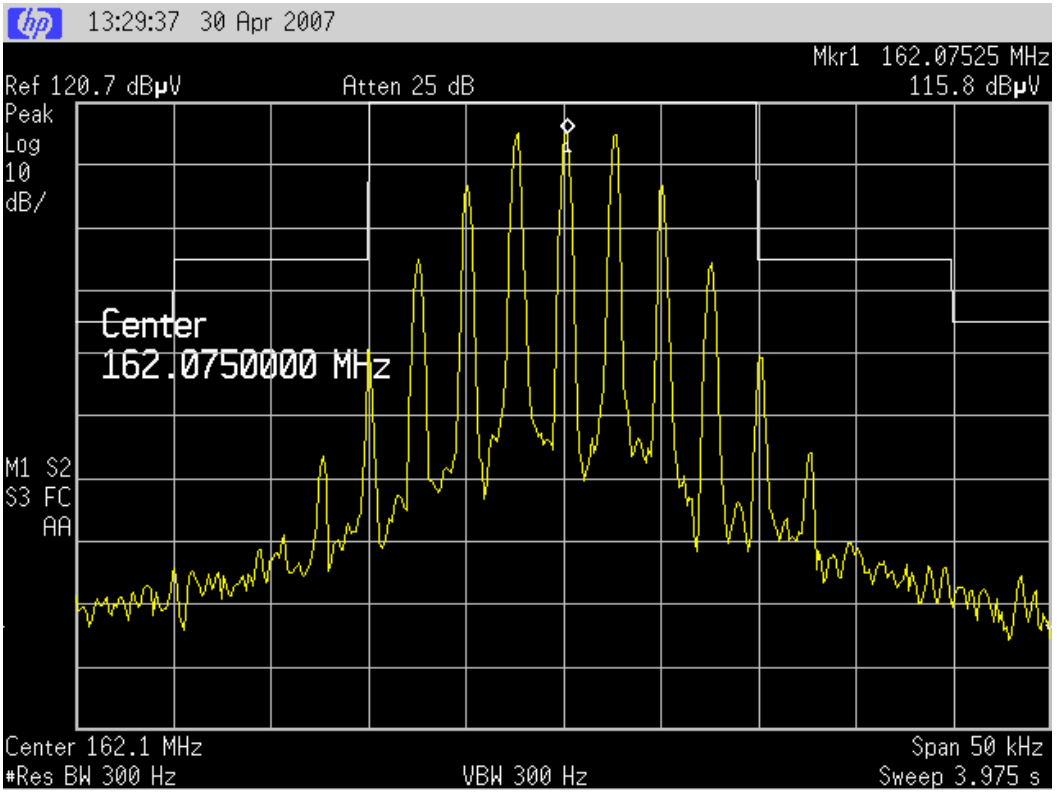
Part 90: F1E 12.5 kHz



Part 90: F3E 25 kHz



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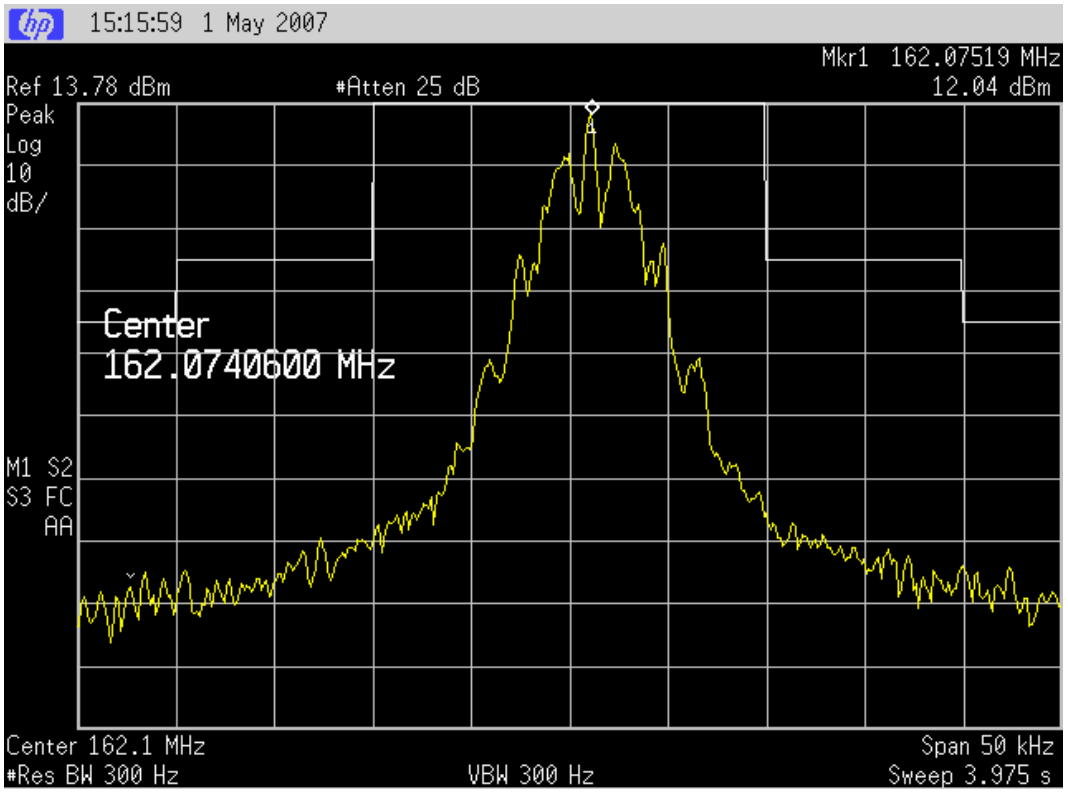
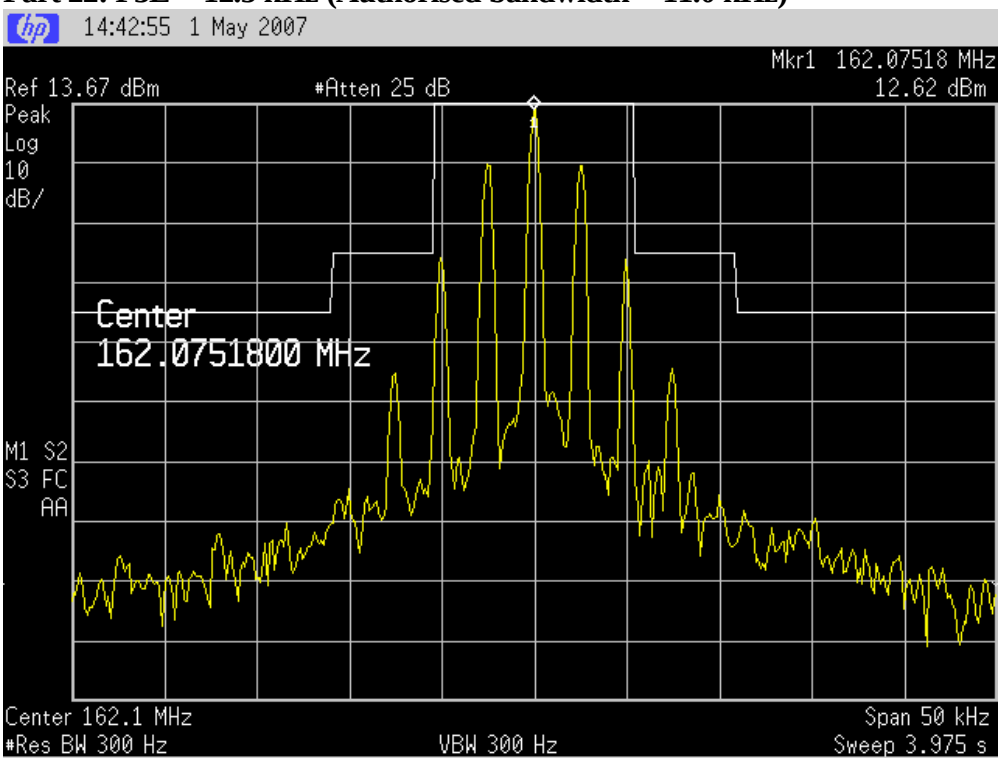
Part 90: F1D 25kHz



Part 22: F3E – 12.5 kHz (Authorised bandwidth = 11.0 kHz)



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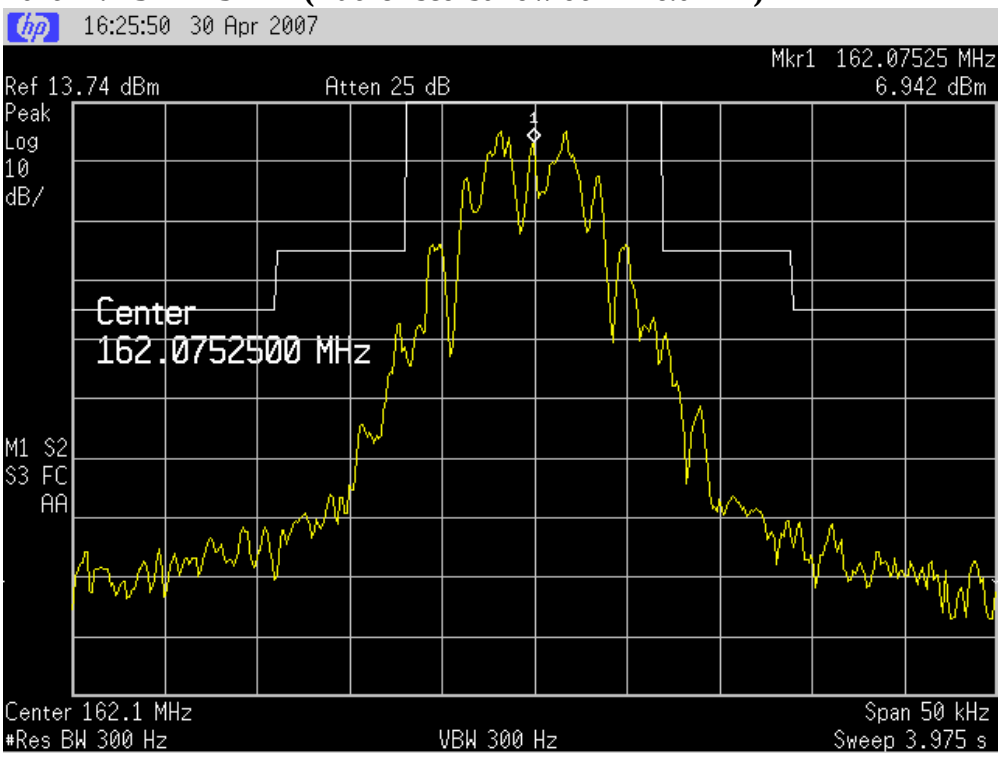
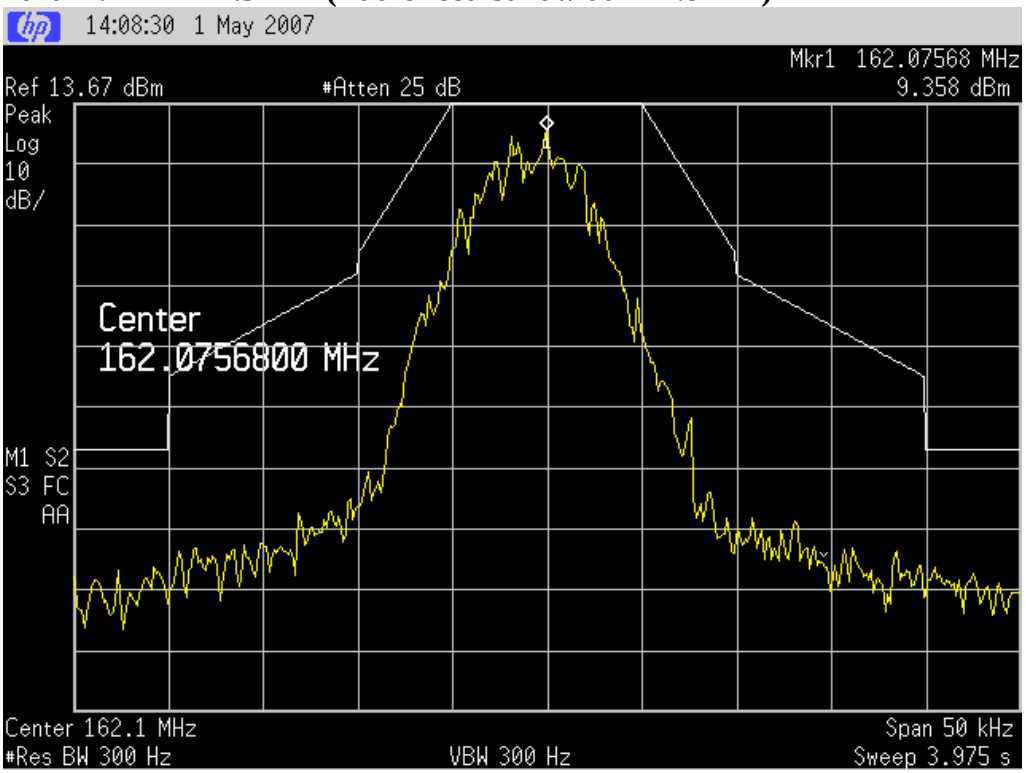
Part 22: F3E – 25 kHz (Authorised bandwidth = 16.0 kHz)



Part 22: F1E – 12.5 kHz (Authorised bandwidth = 7.8 kHz)



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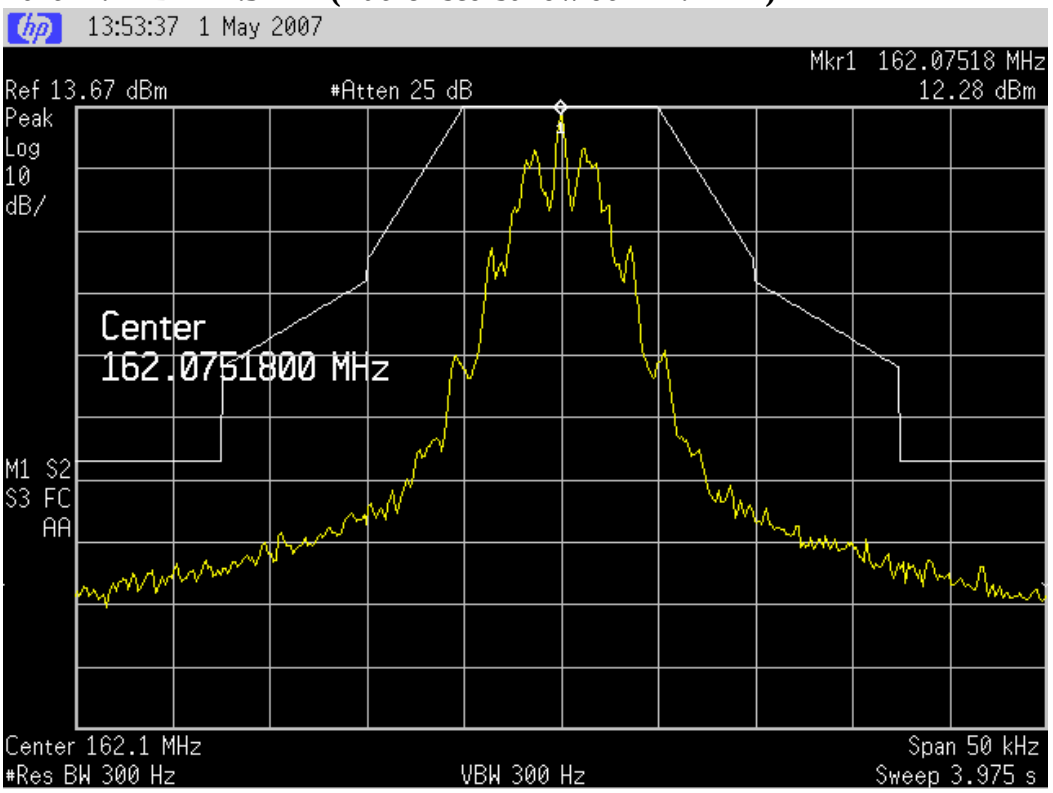
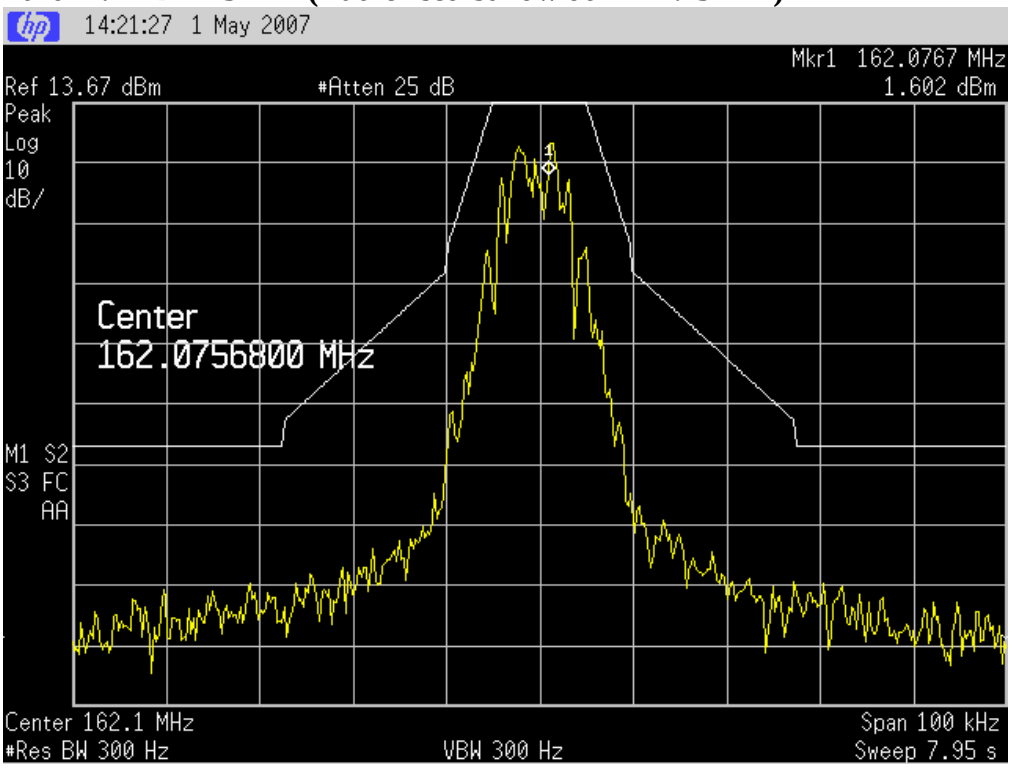
Part 22: F1D – 12.5 kHz (Authorised bandwidth = 7.2 kHz)



Part 22: F1D – 25 kHz (Authorised bandwidth = 11.15 kHz)



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Transmitter spurious emissions at the antenna terminals

Frequency: 162.075 MHz

Spurious emission (MHz)	Emission level (dBm)	Limit (dBm)
324.150	-53.0	-20.0
486.225	-51.0	-20.0
648.300	-47.0	-20.0
810.375	-50.0	-20.0

Limit:
Part 90.210(d) Mask D, (3) on any frequency removed from the centre of the authorised bandwidth by a displacement frequency of more than 12.5 kHz shall be attenuated by at least 50 + 10 log (P) or 70 dB whichever is the lesser attenuation.

The spurious emission limit defined by Mask D has been applied as this transmitter can operate using channel spacings of 12.5 kHz.

Part 2.1051 states that emissions greater than 20 dB below the limit need not be specified.

Part 2.1057 states that the spectrum should be investigated up to the 10th harmonic if the transmitter operates below 10 GHz.

A rated power of 25.0 watts gives a limit of –20 dBm.

Some emissions less that –40 dBm have been reported for completeness.

No measurements were made above the 10th harmonic.

Result: Complies

Measurement Uncertainty: ±3.3 dB

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Receiver spurious emissions at antenna terminals

Receive frequencies: 162.0750 MHz

Intermediate frequency: 45.000 MHz

Measured Spurious Emission		
Spurious emission (MHz)	**Emission level (dBm)**	**Limit (dBm)**
207.0750	-110.0	-57.0

All other emissions observed less than –90.0 dBm.

Limit:
In accordance with CFR 47 Part 15, section 15.111 the power of any emission at the antenna terminal should not exceed 2 nW (–57.0 dBm).

Result: Complies
Measurement Uncertainty: ±3.3 dB

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Field strength of the transmitter spurious emissions

Frequency: 162.075 MHz

Type 9030 control head - Standby emissions

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)
31.3400	21.5	-75.9	-20.0	Vertical	55.9
33.1825	21.4	-73.8	-20.0	Vertical	53.8
44.2475	18.0	-77.2	-20.0	Vertical	57.2
49.7750	16.8	-78.4	-20.0	Vertical	58.4
51.6200	21.0	-74.2	-20.0	Vertical	54.2
49.9350	16.5	-78.7	-20.0	Vertical	58.7
53.4625	19.7	-75.5	-20.0	Vertical	55.5
55.3075	23.9	-71.3	-20.0	Vertical	51.3
57.1525	15.8	-79.4	-20.0	Vertical	59.4
58.9975	21.0	-74.2	-20.0	Vertical	54.2
60.8425	22.7	-72.5	-20.0	Vertical	52.5
122.8775	25.1	-70.1	-20.0	Vertical	50.1

Type 9030 control head – Transmit emissions

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)
324.1500	49.6	-47.8	-20.0	Vertical	27.8
324.1500	50.4	-44.8	-20.0	Horizontal	24.8
486.2250	27.3	-67.9	-20.0	Vertical	47.9
486.2250	42.6	-52.6	-20.0	Horizontal	32.6
648.3000	41.2	-54.0	-20.0	Vertical	34.0
648.3000	44.0	-51.2	-20.0	Horizontal	31.2
810.3750	47.8	-47.4	-20.0	Vertical	27.4
810.3750	44.0	-51.2	-20.0	Horizontal	31.2
972.4500	33.9	-61.3	-20.0	Vertical	41.3
972.4500	33.1	-62.1	-20.0	Horizontal	42.1
1134.5250	32.0	-63.2	-20.0	Vertical	43.2
1134.5250	35.8	-59.4	-20.0	Horizontal	39.4
1296.6000	-	-	-20.0	Vertical	-
1296.6000	-	-	-20.0	Horizontal	-
1458.6750	-	-	-20.0	Vertical	-
1458.6750	-	-	-20.0	Horizontal	-
1620.7500	-	-	-20.0	Vertical	-
1620.7500	-	-	-20.0	Horizontal	-

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Type 9022 control head - Standby emissions

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)
30.7300	28.1	-69.3	-20.0	Vertical	49.3
34.5675	34.6	-60.6	-20.0	Vertical	40.6
38.4100	23.5	-71.7	-20.0	Vertical	51.7
46.0925	21.0	-74.2	-20.0	Vertical	54.2
49.9350	16.5	-78.7	-20.0	Vertical	58.7
53.7750	19.7	-75.5	-20.0	Vertical	55.5
57.6000	19.3	-75.9	-20.0	Vertical	55.9
61.4600	20.2	-75.0	-20.0	Vertical	55.0
65.2975	20.2	-75.0	-20.0	Vertical	55.0
76.8250	20.2	-75.0	-20.0	Vertical	55.0
188.2200	20.5	-74.7	-20.0	Vertical	54.7
111.3925	17.1	-78.1	-20.0	Vertical	58.1
122.8750	25.2	-70.0	-20.0	Vertical	50.0
126.7625	21.8	-73.4	-20.0	Vertical	53.4
153.5950	27.1	-68.1	-20.0	Vertical	48.1

Type 9022 control head – Transmit emissions

Frequency (MHz)	Level (dBuV/m)	Power (dBm)	Limit (dBm)	Polarity	Margin (dB)
324.1500	52.3	-45.1	-20.0	Vertical	25.1
324.1500	53.0	-42.2	-20.0	Horizontal	22.2
486.2250	31.0	-64.2	-20.0	Vertical	44.2
486.2250	42.9	-52.3	-20.0	Horizontal	32.3
648.3000	45.7	-49.5	-20.0	Vertical	29.5
648.3000	44.5	-50.7	-20.0	Horizontal	30.7
810.3750	45.5	-49.7	-20.0	Vertical	29.7
810.3750	42.9	-52.3	-20.0	Horizontal	32.3
972.4500	35.3	-59.9	-20.0	Vertical	39.9
972.4500	35.6	-59.6	-20.0	Horizontal	39.6
1134.5250	38.2	-57.0	-20.0	Vertical	37.0
1134.5250	38.4	-56.8	-20.0	Horizontal	36.8
1296.6000	-	-	-20.0	Vertical	-
1296.6000	-	-	-20.0	Horizontal	-
1458.6750	-	-	-20.0	Vertical	-
1458.6750	-	-	-20.0	Horizontal	-
1620.7500	-	-	-20.0	Vertical	-
1620.7500	-	-	-20.0	Horizontal	-

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When operating in transmit mode no significant emissions were detected between the harmonic emissions that were detected.

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on January 18th, 2007

The transmitter was tested while transmitting continuously while attached to a dummy load.

The power level of each emission was determined by replacing the transmitter with a dipole antenna that was connected to a signal generator. The signal generator output level was increased until the same field strength level was observed at each emission frequency.

The level recorded is the signal generator output level in dBm less any gains / losses due to the coax cable and the dipole antenna.

Limit:
All spurious emissions are to be attenuated by at least 50 + 10 log (P).

The rated power of 25 watts gives a limit of –20 dBm.

No measurements were made above the 10^{th} harmonic.

Result: Complies
Measurement Uncertainty: ±4.1 dB

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Field strength of the receiver spurious emissions

Frequencies: 150.075 MHz, 162.075 MHz, 173.975 MHz

Intermediate frequency: 45.000 MHz

Testing was carried out using both a 9022 and 9030 head and microphone assembly

150.075 MHz. Type 9022 Microphone.

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit	Margin (dB)	Polarity
195.0750	-	-	43.5	-	Hort/Vert
390.1500	-	-	46.0	-	Hort/Vert
585.2250	-	-	46.0	-	Hort/Vert
780.3000	-	28.4	46.0	17.6	Horizontal
975.3750	34.5	34.7	54.0	19.3	Horizontal
1170.4500	33.9	-	54.0	20.1	Vertical

162.075 MHz. Type 9022 Microphone

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit	Margin (dB)	Polarity
207.0750	-	-	43.5	-	Hort/Vert
414.1500	-	-	46.0	-	Hort/Vert
621.2250	-	-	46.0	-	Hort/Vert
828.3000	-	29.9	46.0	16.1	Horizontal
1035.3750	32.5	32.1	54.0	21.5	Vertical
1242.4500	31.0	-	54.0	23.0	Vertical

173.975 MHz Type 9022 Microphone

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit	Margin (dB)	Polarity
218.9750	-	-	43.5	-	Hort/Vert
437.9500	15.2	21.0	46.0	25.0	Horizontal
656.9250	-	-	46.0	-	Hort/Vert
875.9000	30.6	29.4	46.0	15.4	Vertical
1094.8750	31.5	34.1	54.0	19.9	Horizontal

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150.075 MHz. Type 9030 Microphone

Frequency (MHz)	Vertical (dBuV/m)	Horizontal (dBuV/m)	Limit	Margin (dB)	Polarity
195.0750	-	-	43.5	-	Hort/Vert
390.1500	-	-	46.0	-	Hort/Vert
585.2250	-	-	46.0	-	Hort/Vert
780.3000	-	28.6	46.0	17.4	Horizontal
975.3750	35.1	35.4	54.0	18.6	Horizontal
1170.4500	32.4	-	54.0	21.6	Vertical

Testing was carried out completely on the Type 9022 head with a test on only one channel using a Type 9030 to confirm that the results were similar.

Device was tested on an open area test site at a distance of 3 metres.

Testing was carried out at EMC Technologies NZ Ltd Open Area Test Site, which is located at Driving Creek, Orere Point, Auckland. Details of this site have been filed with the Commission, Registration Number: 90838, which was last updated on January 18th, 2007.

Below 1000 MHz a quasi peak detector was used with a bandwidth of 120 kHz.

Above 1000 MHz an average detector was used with a bandwidth of 1 MHz.

The receiver was tested while receiving continuously while attached to a dummy load.

Limit:
The field strength limits as per CFR 47 Part 15, section 15.109 have been applied.

Result: Complies

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Frequency Stability

Frequency stability measurements were between - 30 °C and + 50°C in 10°C increments.

At each temperature the transmitter was given a period of 30 minutes to stabilise. The transmitter was then turned on and the frequency error measured after a period of 1 minute.

Measurements were made with the supply varied between 115% and 85% of the nominal supply voltage (13.8 Vdc).

Nominal Frequency: 162.075 MHz

Frequency Error (Hz)			
Voltage / **Temp.**	**11.7 Vdc**	**13.8 Vdc**	**15.9 Vdc**
+50° C	-18.0	-16.0	-15.0
+40° C	-13.0	-12.0	-13.0
+30° C	+5.0	+6.0	+5.0
+20° C	+19.0	+22.0	+23.0
+10° C	+23.0	+21.0	+21.0
0° C	+41.0	+42.0	+43.0
-10° C	+122.0	+125.0	+128.0
-20° C	+135.0	+138.0	+140.0
-30° C	+143.0	+143.0	+150.0

Limit:
Part 22.355 and Part 90.213 state that mobile station transmitters operating between 150 – 174 MHz with 12.5 kHz channelling are required to have a frequency tolerance of 5 ppm.

This transmitter operates on 162.0750 MHz. 5 ppm = 5 x 162 = 810 Hz.

Result: Complies
Measurement Uncertainty: ±30 Hz

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Transient frequency behaviour

Transient frequency behaviour measurements are applicable to wide band and narrow band transmitters operating in the frequency band 150-174 MHz. Measurements were carried out at 162.075 MHz using the method described in TIA-603 and EN 300-086. In summary this method calls for the use of an external signal generator tuned to 162.075 MHz with a output level 0.1 % (-30 dB) of the level from the transmitter with a 1 kHz tone with a frequency deviation of 12.5 kHz being applied to the input of a modulation analyser along with the output from the transmitter.

The modulation analyser produces an amplitude difference signal and a frequency difference signal, which are applied to the input of a storage oscilloscope.

The unmodulated transmitter is then keyed which produces a trigger pulse that is AC coupled to the oscilloscope that produces a display on the screen.

The result of the change in the ratio of power between the test signal from the signal generator and the transmitter output will produce 2 separate sides on the oscilloscope picture. One will show the 1000 Hz test modulation and the other will be the frequency difference of the transmitter versus time.

Measured Transient Deviation		
Period t_1 (ms)	period t_2 (ms)	period t_3 (ms)
5.0	20.0	5.0
Frequency Difference from the Nominal Frequency (kHz)		
Nil Nil	Nil Nil	Nil Nil

Limits:

Channel Spacing (kHz)	Transmitter Period t_1 (kHz)	Transmitter Period t_2 (kHz)	Transmitter Period t_3 (kHz)
12.5 25.0	± 12.5 ± 25.0	± 6.25 ± 12.5	± 12.5 ± 25.0

Result: Complies

Measurement Uncertainty: Frequency difference ±1.6 kHz

Time period ±1 ms

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12.5 kHz transmitter turn on

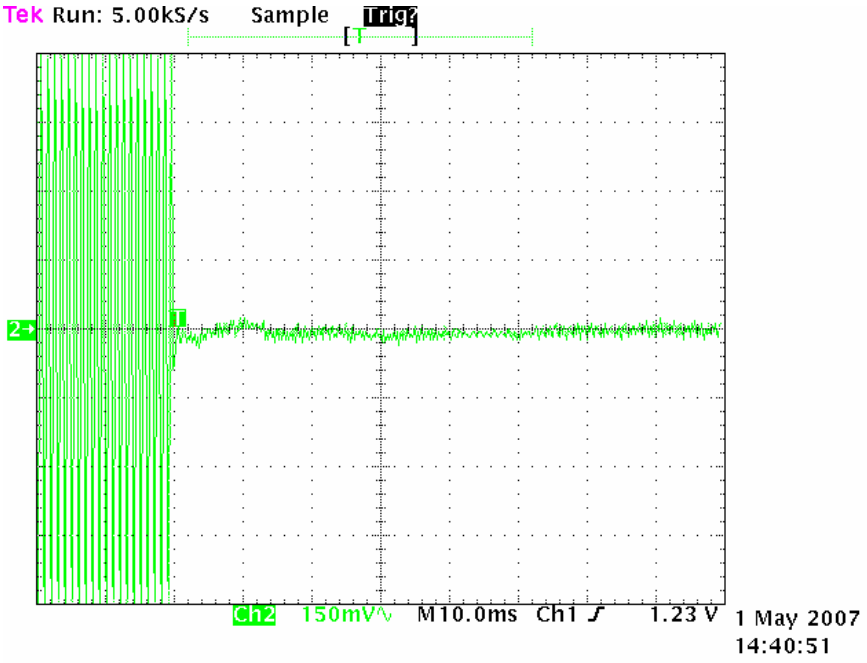
Green Trace = 1 kHz tone with FM deviation of 12.5 kHz and any transient.

Green trace has been maximised to give full screen indication of a ±12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 mS).
This is position *t*on.

*t*1 occurs between 2.0 and 2.5 divisions from the left-hand edge.
t2 occurs between 2.5 and 4.5 divisions from the left-hand edge.

No transient can be observed just after *t*on.



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12.5 kHz transmitter turn off

Green Trace = 1 kHz tone with FM deviation of 12.5 kHz and any transient.

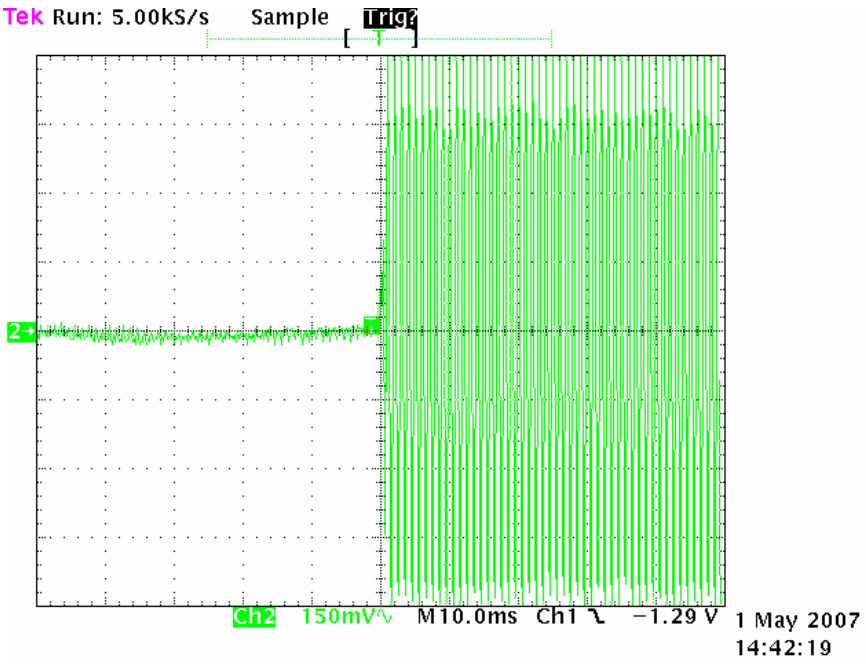
Green trace has been maximised to give full screen indication of a ± 12.5 kHz.
Therefore each Y axis division = 3.125 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 mS).

This is position *t*off.

*t*3 occurs between 4.5 and 5.0 divisions from the left hand edge.

No transient response can be observed just before toff.



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25 kHz transmitter turn on

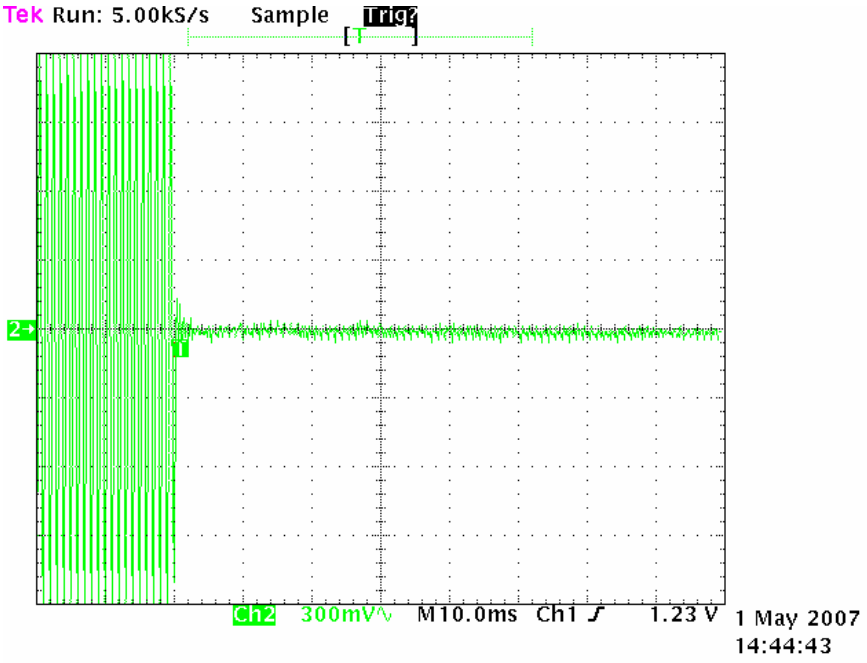
Green Trace = 1 kHz tone with FM deviation of 25 kHz and any transient.

Green trace has been maximised to give full screen indication of a ±25 kHz.
Therefore each Y axis division = 6.25 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

Triggering has been set to occur 2 divisions from the left hand edge (20 mS).
This is position *t*on.

*t*1 occurs between 2.0 and 2.5 divisions from the left-hand edge.
t2 occurs between 2.5 and 4.5 divisions from the left-hand edge.

No transients can be observed just after *t*on.



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25 kHz transmitter turn off

Green Trace = 1 kHz tone with FM deviation of 25 kHz and any transient.

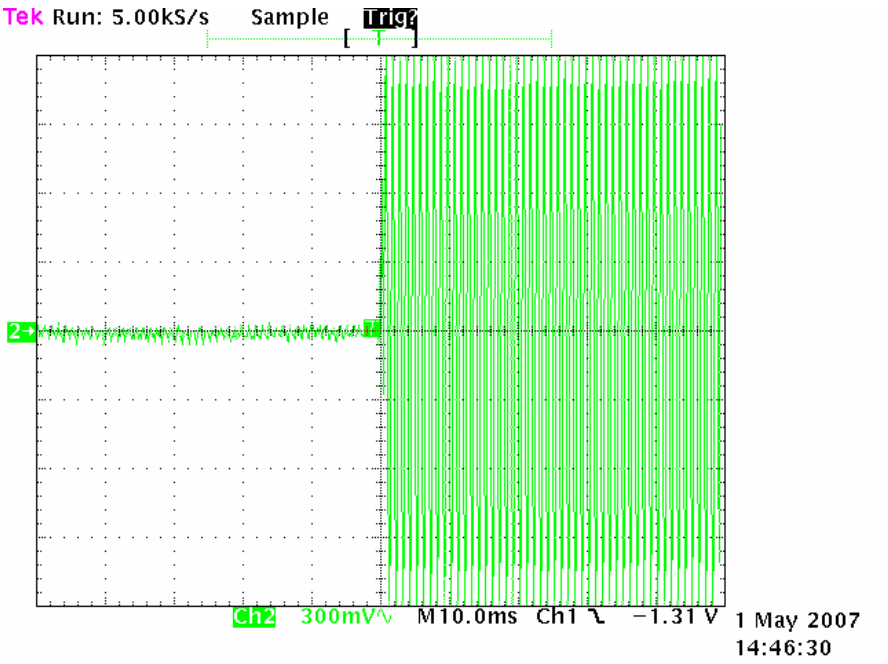
Green trace has been maximised to give full screen indication of a ± 25 kHz.
Therefore each Y axis division = 6.25 kHz per division.
The X axis has been set to a sweep rate of 10 mS/division.

The display of the 1 kHz signal rising has been positioned 5 divisions from the left hand edge (50 mS).

This is position *t*off.

*t*3 occurs between 4.5 and 5.0 divisions from the left hand edge.

No transient can be observed just before toff.



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Radio Frequency Hazard Information

As per Section 1.1310 and Section 2.1091 certification of this transmitter is sought using the Controlled / Occupational exposure limits as detailed in OST/OET Bulletin Number 65 as a power of 25 watts is to be used in a mobile environment where the use of the transmitter will be employment related.

Calculations have been made using the General Public/Uncontrolled Exposure limits.

Minimum safe distances have been calculated below.

Power density, $mW/m^2 = E^2/3770$

- Occupational / Controlled Exposure limit will be 1 mW/cm^2

- General Population / Uncontrolled exposure limit will be 0.2 mW/cm^2

The minimum distance from the antenna at which the MPE is met is calculated from the equation relating field strength in V/m, transmit power in watts, transmit antenna gain, transmitter duty cycle and separation distance in metres:

$E, V/m = (\sqrt{(30 * P * G)}) / d$

Controlled

$E = 1\ mW/cm^2 = E^2/3770$

$E = \sqrt{1*3770}$

$E = 61.4\ V/m$

Uncontrolled

$E = 0.2\ mW/cm^2 = E^2/3770$

$E = \sqrt{0.2*3770}$

$E = 27.5\ V/m$

The rated maximum transmitter power = 25 watts.

Transmitter operated using a quarter wave whip antenna with a gain of 2.15 dBi (1.64).

The transmitter is a push to talk device that would typically be used with a duty cycle of 50% in a 6 minute period or a 30 minute period.

Controlled

$d = \sqrt{(30 * P * G*DC) / E}$

$d = \sqrt{(30 * 25.0 * 1.64 * 0.5) / 61.4}$

d = 0.4 metres or 40 cm

Uncontrolled

$d = \sqrt{(30 * 25.0 * 1.64 * 0.5) / 27.5}$

d = 0.9 metres or 90 cm

Result: Complies

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8. TEST EQUIPMENT USED

Instrument	Manufacturer	Model	Serial #	Asset
Aerial Controller	EMCO	1090	9112-1062	RFS 3710
Aerial Mast	EMCO	1070-1	9203-1661	RFS 3708
Attenuator 10 dB	Hewlett Packard	HP8491A	24838	E1329
Attenuator 20 dB	Weinschel	49-20-43	GC-104	E1308
Audio Analyzer	Hewlett Packard	8903A	2216A01713	E1146
Biconical Antenna	Schwarzbeck	BBA 9106		RFS 3612
Frequency Counter	Hewlett Packard	HP 5342A	1916A01713	E1224
Level generator	Anritsu	MG443B	M61689	E1143
Log Periodic Antenna	Schwarzbeck	VUSLP9111	9111-228	3785
Measurement Receiver	Rohde & Schwarz	ESCS 30	847124/020	E1595
Modulation Analyzer	Rohde & Schwarz	FMA	837807/020	E1552
Modulation Analyzer	Hewlett Packard	8901B	2608A00782	E1090
Oscilloscope	Tektronics	745A	B010643	1569
Power Attenuator	Weinschel	49-20-43	GC104	E1308
Power Supply	Hewlett Packard	6032A	2743A-02859	E1069
RF Power Meter	Hewlett Packard	HP 436A	2512A22439	E1198
Rubidium Oscillator	Ball Efratom	FRS – C	4287	E1053
Selective Level Meter	Anritsu	ML422C	M35386	E1140
Signal Generator	Rohde & Schwarz	SMHU.58	838923/028	E1493
Spectrum Analyzer	Hewlett Packard	E7405A	US39150142	3776
Thermal chamber	Contherm	M180F	86025	E1129
Thermometer	DSIR	RT200	035	E1049
Turntable	EMCO	1080-1-2.1	9109-1578	RFS 3709

9. ACCREDITATIONS

Testing was carried out in accordance with EMC Technologies NZ Ltd registration with the Federal Communications Commission as a listed facility, Registration Number: 90838, which was last updated on January 18th, 2007.

All testing has been carried out in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to ISO/IEC 17025.

All measurement equipment has been calibrated in accordance with the terms of EMC Technologies (NZ) Ltd's International Accreditation New Zealand (IANZ) Accreditation to ISO/IEC 17025.

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10. PHOTOGRAPH (S) Transmitter and Accessories External Views

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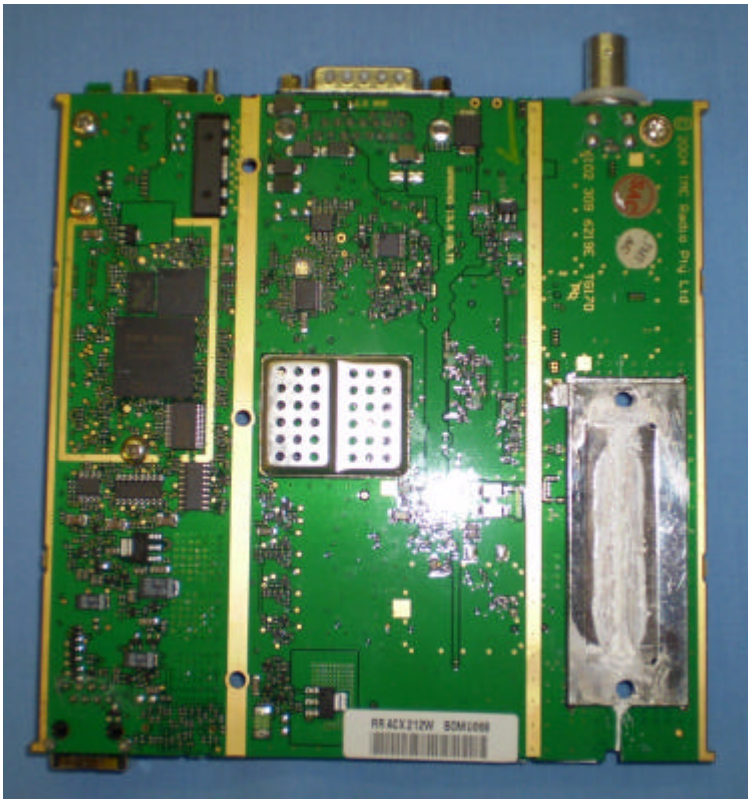
Transmitter Internal Views



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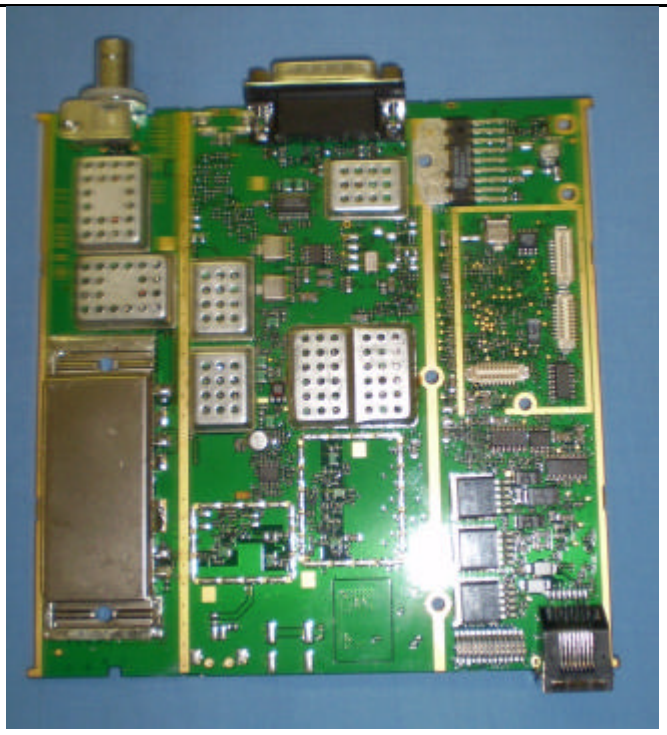

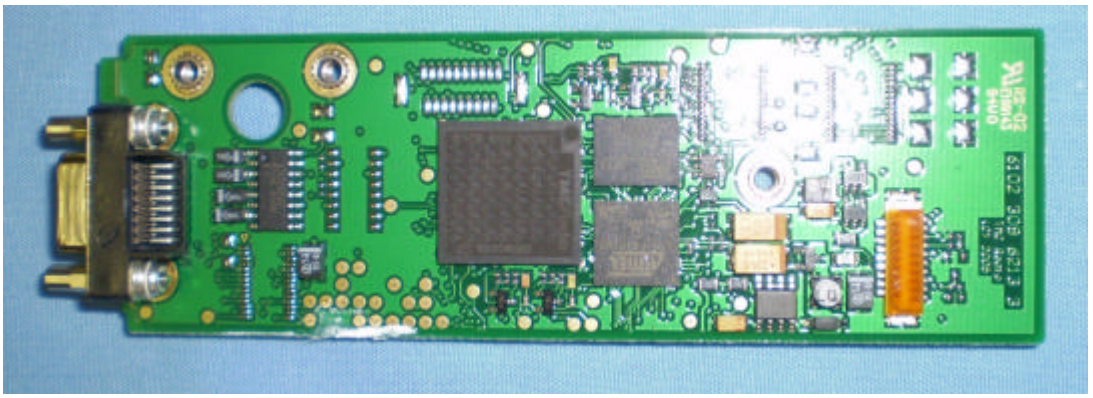

9030 Head External View

9022 Head External and Internal Views

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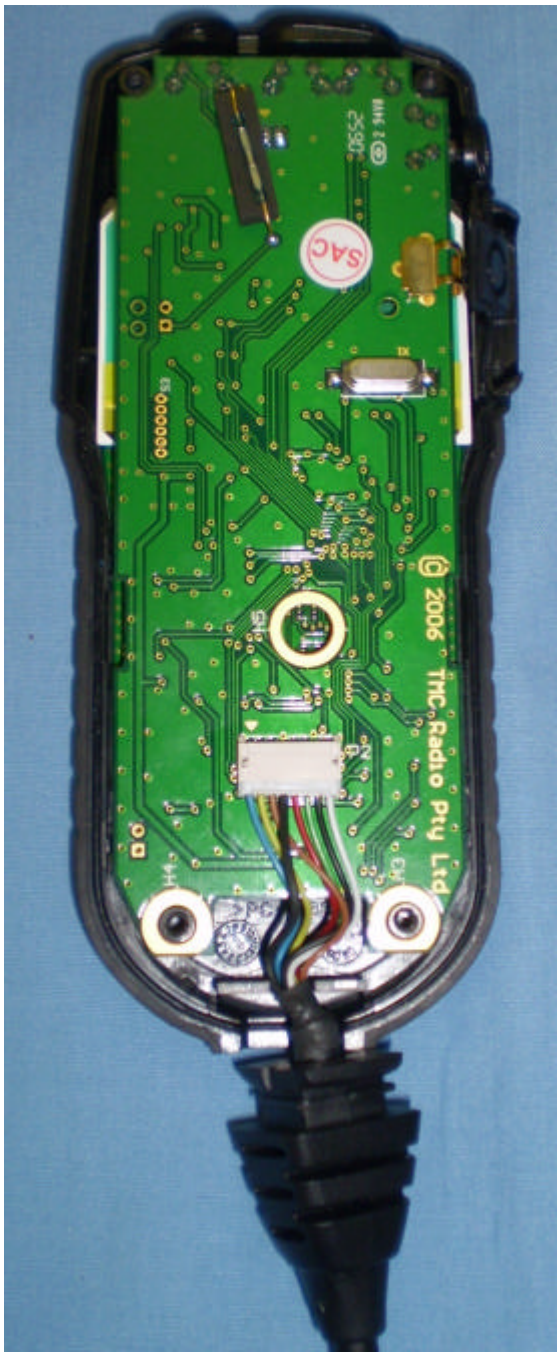

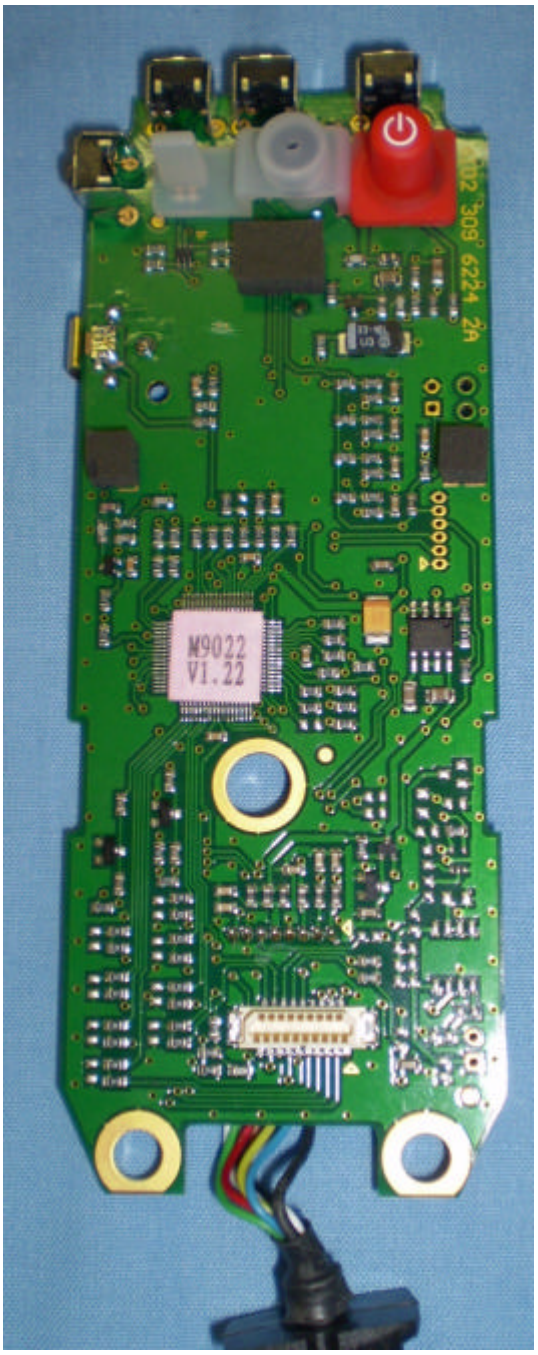

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Radiated emissions test set up – Type 9030 head

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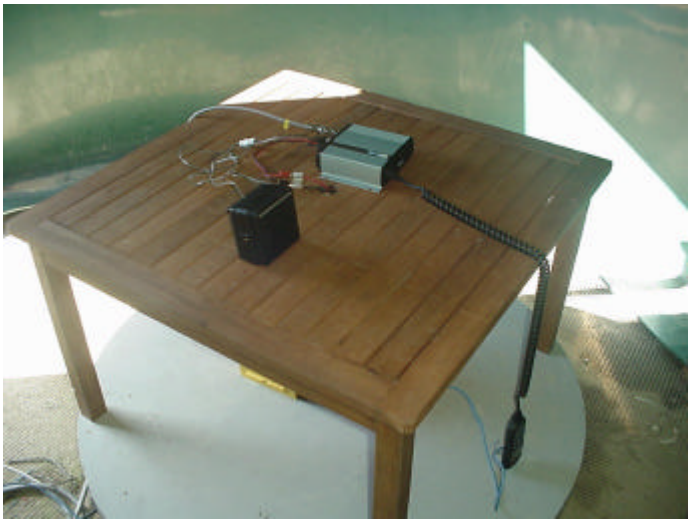
Radiated emissions test set up – Type 9022 head



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